

5 CONCLUSIONS

Steady erosion has threatened the Village of Kivalina for nearly two decades. The potential loss of the town site to the encroaching sea is a dire concern for the community. Storms in the winter of 2004 caused the erosion of the beach near the school and fuel farm. One occupied house was undercut by erosion and had to be evacuated. In 2005, storms have threatened the airport runway, school housing, and the fuel farm, and the season for fall storms is not yet over. With each new storm, the threat of erosion continues.

The existing town site is already limited in land, as it is surrounded by water on all sides. Sanitation is insufficient and presents a serious health issue for residents. Recent projects to upgrade sanitation have been cancelled because the funding agencies will not fund projects that are threatened by erosion. Funding agencies are also reluctant to fund improvements to the existing town site, since the community may have to be relocated. Ongoing housing shortages, a general lack of community sanitation systems, and a pressing situation with ongoing erosion have led the community to pursue relocation of the village.

5.1 Challenges With All Sites Currently Under Consideration

Any of the sites under consideration for Kivalina relocation that are analyzed in this report can be technically constructed. However, the analysis conducted for this report, including siting criteria and site evaluations, indicate that none of the sites currently under consideration are ideal for relocation. Previous and recent geotechnical investigations indicated that soils are ice-rich under all the sites being considered except the current Kivalina site and Tatchim Isua. No potential town sites rank high in all four of the major site evaluation criteria

categories: physical environment, construction and utilities factors, social and access factors, and cost implications. This is best illustrated by a comparison of Kiniktuuraq and Tatchim Isua.

Kiniktuuraq was chosen by referendum as the community's preferred site for relocation in 2000. It is favorable in terms of location near the existing site and location for subsistence access. The site requires minimal access roads and has good barge access. It also ranks high in terms of subsistence-related and O&M costs, and many in the community are comfortable with the site. However, Kiniktuuraq is subject to coastal erosion and flooding, and is underlain by permafrost. Site preparation may require a substantial amount of gravel (a minimum of 9 feet) to elevate it above flood levels and insulate the permafrost. Given current trends in climate change, this and all other low-lying coastal sites are likely to prove infeasible.

Tatchim Isua is not particularly good for access to subsistence resources. Its general location makes access to subsistence resources problematic, and shallow water depth at the end of the Kivalina Lagoon limits boat access. For this and other cultural reasons, the community does not appear to be comfortable with the site. The site may also require access roads to both barge landings and boat launch areas, and the location of water supply has yet to be identified. However, the site is above any coastal or riverine flood elevations, and has the best soils of any of the sites under consideration. The site may likely require the least amount of gravel of any of the sites under consideration.

As shown above, Kiniktuuraq, selected by the community as the preferred site, and Tatchim Isua, the best site from a construction standpoint, both present difficulties. The other sites under

consideration are even more problematic. Coastal sites are the most susceptible to erosion and flooding. Some coastal and riverine sites are also underlain by permafrost. Gravel pad and other site preparation requirements would be extensive, and could still be subject to erosion, flooding, and other storm damage over time. Low lying sites are likely to experience problems with sewage disposal, landfills, and water supply. Sites that are located above areas prone to flooding and erosion are less likely to have good coastal and river access for subsistence activities or barges that supply fuel and freight. They may require longer access roads to areas that provide boat and barge access. There is less community comfort with these sites compared to coastal and river sites, and they may entail increased costs associated with subsistence activities due to longer travel times.

The comparison of those two sites also shows that even sites with good coastal and riverine access for subsistence and traditional use purposes may be insufficient to support the new village immediately. Both the new site and the existing town site must be maintained during relocation.

5.2 Rapidly Changing Environmental Conditions

There is ample evidence that environmental conditions in the Arctic, including the Kivalina area, have been changing rapidly. These changes may be linked to long-term climate change, and include:

- **More severe fall storms** – fall storms on the Chukchi Sea are more severe and can occur later in the fall/winter season.
- **More severe erosion and flooding** – the severity of fall storms, coupled with delays in ice formation on the Bering Sea, have increased the

frequency and severity of erosion and flooding events at Kivalina.

- **Accelerated permafrost melting** – communities throughout the Alaskan arctic are seeing an increase in permafrost melting and subsequent ground settlement.

These changes have significant ramifications in selecting a relocation site that will be safe and can be maintained over the long term. They also have significant implications for construction design and costs of sites that are subject to these climate change-related events. Even if designed properly, long-term trends make it difficult to maintain integrity and could entail continual O&M costs. Based on the increasing threats to low-lying sites along the coast and rivers, and to ice-rich sites in general, further consideration of the existing Kivalina site, Kiniktuuraq, Kuugruaq, Igrugaivik, and Simiq are not recommended for further consideration. Only Imnakuk Bluffs and Tatchim Isua should remain under consideration.

Due to the challenges with existing sites, it may be appropriate to consider additional sites. Any consideration of additional sites should include consideration of long-term climate changes. Potential sites include a higher rocky area behind the Simiq site, and a location that could access both the Wulik River and the Red Dog road system. It cannot be over-emphasized that any sites for future consideration should be subject to geotechnical investigation to determine the presence and nature of ice in the soil.

5.3 Cost Considerations

Appendix A indicates that while there is a wide range in the total relocation costs between the sites, given the assumptions identified for this study, the least expensive site is over \$150 million (Tatchim Isua), and the most expensive site is nearly \$252

million (Simiq). Site preparation and construction is by far the major cost element of relocation, ranging from approximately one-third to over two-thirds of total relocation costs, and gravel for site pads and roads is the most significant component of site preparations. Because of the need to elevate sites above flooding levels and/or insulating ice-rich soils, cost estimates included an assumption of a gravel pad at least 9 feet thick due to the substantial amount of gravel required to prevent melting the permafrost. Part of the high cost was an assumed need to import the volume of gravel required.

New approaches to the volume and source of gravel are needed. Alternative design assumptions such as aboveground utilities, flush and haul systems, boardwalks, pile building foundations, and use of gravel capped pads could reduce the amount of gravel required. Local sources of gravel, such as Tatchim Isua and the mountain behind Simiq could also reduce gravel costs, if the volume and characteristics of the gravel on those sites are suitable for construction purposes.

Costs associated with site and facility operations and maintenance, access to airports and ports, and additional travel time for subsistence and other traditional activities are vital considerations. Longer distances to airports, ports and subsistence areas can substantially increase fuel costs and raise safety concerns.

Sites with continued exposure to flooding, erosion, and permafrost melting may have ongoing and potentially costly maintenance requirements.

Finally, initiating and sustaining Kivalina relocation activities will require a large infusion of funding. Such an amount is beyond the normal program capacity of state and federal agencies, and would likely require a combination of specific funding

actions by Congress and the Alaska State Legislature.

5.4 Schedule Considerations

Appendix C addresses the master schedule for relocation. Given the number of agencies involved, necessary approvals, facility requirements, and complexity of Kivalina relocation in addition to design, permitting, NEPA compliance requirements, and construction timeframes would result in a schedule of at least 10 years. Relocation of Kivalina cannot wait 10 years, given current conditions and threats to safety and property. A streamlined emergency response approach needs to be applied to shortening the schedule, with a single agency involved as overall lead for relocation. All participating agencies must recognize the severity of the risk to Kivalina, and work together to shorten program and regulatory requirements. This type of approach could shorten the schedule for relocation to three to five years. In the meantime, some form of effective emergency erosion and flood protection needs to be installed at Kivalina to protect lives and property.

5.5 The Community Situation Is Dire

As indicated throughout the report and in preceding sections of the conclusions, the current situation in Kivalina is dire. Fall storms are increasing in severity and frequency, and a significant amount of shoreline has been lost in the last two years alone. Erosion is threatening to damage the airport runway, school and associated housing, and the fuel farm. Should this occur, it could become difficult to maintain a functioning community. While an emergency evacuation plan has been completed, plans for an emergency evacuation road are under way, and some limited local erosion protection has been put in place, more immediate and coordinated action is needed. Without action, Kivalina does not have even five years for relocation.

5.6 New Relocation Solutions Are Needed

More work is needed prior to taking the next step of design or construction, and this involves some new thinking. Ongoing water source studies and geotechnical investigations may confirm the suitability of certain sites for construction. Site control for the selected relocation site may have to be obtained. Native allotments overlap or border Tatchim Isua, Imnakuk Bluff and Kuugruaq.

Relocation Schedule. Based on uninterrupted steady progression of funding, design, and construction, it would take 10 years to completely move the village to a new site. Maintaining a 10-year schedule is optimistic under current regulations. A key feature of maintaining schedule is to obtain funding for the master planning stages; detailed feasibility studies; environmental studies; and seed money to start construction of major components such as airports, roads, harbors, and site grading/pad. The community of Kivalina, Northwest Arctic Borough, and participating state and federal agencies need to develop an accelerated schedule that protects the public interest in environment and expenditure funds while expediting response to an emergency situation.

Relocation Costs. In 2005 dollars, construction cost estimates to move the village range from \$123 million to \$249 million. Costs need to be adjusted during progression of the project to account for inflation and to add engineering and construction management costs. New approaches and assumptions for gravel requirements and source, site design, and facility design can reduce relocation costs, as potentially can the consideration of a limited number of new sites. These items need to be investigated immediately

Agency Coordination. In order to move Kivalina, agency coordination is critical. Currently, the Corps of Engineers is assisting with the initial planning stages. However, it does not have funds and specific authority to lead the project past the planning stages. Other agencies such as ANTHC have a strong role in the community, but they do not have the authority or technical expertise to lead a village relocation project. A strong “lead” agency may be needed to keep the project moving, coordinate with other funding agencies, and to assist the community through the process.

Emergency Erosion Protection. Immediate action is needed to design and construct emergency erosion protection to protect critical community facilities. A system must be funded, designed, and constructed prior to next fall’s storm season(2006).

Finally, while this study has a relocation matrix that shows factors for selecting a site, the initial rankings for a village site may need to be reviewed and updated during public involvement steps between the 95% and 100% reports. At that stage, a recommendation and conclusions can be made about selecting a village relocation site. This final report incorporates the views of the community and other interested agencies, and provides objective information for the community to consider while deciding which alternative plan is most appropriate, affordable, and sustainable.

5.7 Next Steps

The next steps in the relocation process involve three sets of activities.

Pursue Temporary Erosion Protection Measures. Temporary measures are needed to protect the school and fuel facilities from erosion. The community of Kivalina, working with the Northwest Arctic Borough,

Alaska District Corps of Engineers, and other entities such as the Denali Commission should work cooperatively to obtain funding, design and construct suitable erosion protection structures.

Confirm Community Selection for Relocation Site. The community needs to carefully review this report and the advantages and disadvantages associated with each sites, including relative risk and likelihood of receiving addition funding. The choice of a site for relocation should then be confirmed in a formal referendum.

Initiate Next Steps in Implementing Community Relocation. The Master Relocation Schedule in Appendix C lays out the estimated phases and specific steps to proceed from site confirmation to completion of relocation. The next steps in Phase Three, Planning, are as follows:

- Obtain funding for selected site planning and design activities
- Initiate comprehensive master planning for the selected site
- Complete specific infrastructure and utility feasibility studies and initiate grant applications for design and construction
- Identify agency to lead future funding, design and construction efforts associated with relocation
- Acquire design and permitting phase funding

Completion of these steps will lead to initiation of project design phase (Phase 4).